NOTES FOR STUDENTS

Ecological concepts and nomenclature.—All recent discussions of the classification of vegetation make it evident that ecologists are far from agreement upon any one system. The resulting ambiguity and confusion are deplored by both TANSLEY[5] and PAVILLARD.[6] The latter gives further emphasis to his former statement that the species and the association constitute the two fundamental unities of ecology or geobotany, and his two main divisions of the subject are based on these unities. As each of these units may be considered from the floristic, the genetic, and the ecological viewpoint, there results six subdivisions of the science. Considering the desirable implications of the term "phytosociology" when used to designate the study of plant communities, and translating PAVILLARD'S terms freely, the six subdivisions of ecology may be designated: (1) floristic geobotany, (2) genetic gèobotany, (3) ecologic geobotany, (4) floristic phytosociology, (5) genetic phytosociology, and (6) ecologic phytosociology. The first three are devoted to the consideration of the species and the others to the problems of the associations. Something of the content of the various subdivisions has been noted in a previous review.[7]

In the present article PAVILLARD devotes much attention to the considerations which would establish the association as the fundamental unit in the investigation of vegetation. With this TANSLEY seems in agreement, and further holds that such a unit of vegetation should correctly and usefully be regarded as an organic unity or quasi-organism. TANSLEY, however, would limit the application of the term "association" to mature units in relatively stable equilibrium with their environment. These are the climax associations or permanent associations of other ecologists. To transitory or developmental associations he would apply CLEMENTS' term of "associes."

Being in agreement that the association is the fundamental unit of phytosociology, TANSLEY and PAVILLARD emphasize the importance of the study of its development, the former clearly recognizing the principal of "succession" and the existence of both climatic and physiographic (edaphic) climaxes, and the latter devoting one of his subdivisions of the science ("genetic phytosociology") to problems of the development of associations, although he points out that such studies are not often undertaken or appreciated in continental Europe. TANSLEY insists upon the study of the morphology of associations, that they are essentially topographical units, and are in the first instance to be determined empirically, while PAVILLARD regards floristic composition as their most essential characteristic. This floristic composition includes not only accurate lists of the species, but also consideration of the

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[5] TANSLEY, A. G., The classification of vegetation and the concept of development. Jour. Ecol. **8**:118–149. 1920.

[6] PAVILLARD, J., Espèces et associations; essai phytosociologique. Montpellier. pp. 34. Oct. 1920.

[7] BOT. GAZ. **70**:183–185. 1920.

"sociological value of the species," and here perhaps lies the most valuable and suggestive portion of the French writer's contribution. He asserts that the "sociological value" of species depends upon their abundance, dominance, sociability, constancy, affiliation (fidélité), and genetic importance. When "abundance" and "dominance" are determined in a quantitative manner according to RAUNKIAER's[8] methods, "constancy" according to DU RIETZ, affiliation according to BRAUN-BLANQUET, and "genetic importance" according to PAVILLARD, the results will greatly clarify our concept of the association and give a new importance to its floristic study. The "genetic coefficient" expressing the relative importance of the species in the development of the association is perhaps the most important of these concepts and represents a decided contribution from PAVILLARD.

While there is practical agreement as to the importance of associations and little difference as to the use of the term, these two writers fail to agree when it comes to the consideration of units of a higher order. TANSLEY holds that the "formation" corresponds to habitat and cannot be satisfactorily characterized by life forms. He applies the term "formation" to a set of plant communities related developmentally and culminating in one or more associations. On the contrary, PAVILLARD regards life form as the only characteristic of a "formation," which may thus be a community that is but a fragment of an association or one that contains several associations. He does not think that a satisfactory system of classification of plant associations is practicable in the present state of our knowledge.

In attempting, in his admirable discussion, to harmonize the widely divergent opinions and the diverse attitudes of different ecologists, TANSLEY has been the first, perhaps, to appreciate fully the influence not only of difference of training and of centers of interest but also of geographical situation. To himself it is not surprising that American ecologists, with their abundance of entirely natural areas, should belong to a school favoring a system based upon climatic climaxes and succession, or that those located in the middle west or northeast of the United States should appreciate the importance of edaphic factors and distinguish their action from those of climatic origin.

A similar consideration of the influence of geographical situation would probably have been useful to ROMELL[9] in explaining the segregation of Swiss and Scandinavian ecologists in the "inductionist" school, and the American and English scientists in the "successionist" school. He shows, however, that some of the former, notably SERNANDER, have appreciated the dynamics of vegetation and employed many of the methods of the latter. His plea for the use of hypotheses and of experimental methods is excellent, and the

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[8] RAUNKIAER, C., Recherches statistiques sur les formations végétales. Det. Kgl. Danske Videirkabernes Selskabe Biol. Meddeleser I. **3**: pp. 80. 1918.

[9] ROMELL, LARS-GUNNAR, Physionomistique et écologie raisonnée. Svensk Bot. Tidsk. **14**:136–146. 1920.

reviewer is ready to agree with his conclusion that "the watchwords of a rational and reasonable ecology are logic, common sense, and physiological experimentation," and perhaps to echo his "We do not need their dogmatism nor their abominable nomenclature; we have enough of our own."—GEO. D. FULLER.

Alpine adaptations.—In 1884 BONNIER began his classical experiments upon the structural changes induced by growing plants at various altitudes. Plantations were made in the lowlands and at various altitudes in the Alps, so arranged that the two individuals to be compared were produced by dividing one plant. Similar experiments were begun in the Pyrenees in 1886, and the botanical world is familiar with the remarkable results as reported in BONNIER'S earlier publications. Now after a lapse of over 30 years he makes a summary of what are probably the most notable and prolonged experiments of their kind on record.[10]

A few of the plants taken from the plains to alpine stations died, but a list is given of 58 species that proved able to maintain themselves at high altitudes. These have all undergone changes which make them closely resemble indigenous alpine plants. The principal changes are relatively large development of the subterranean as compared with aerial parts, shortening of the leaves and of the internodes of stems, increased hairiness, and relatively larger development of bark and protective tissue. The leaves became thicker in proportion to their surface and are a deeper green, with more highly developed palisade tissue and a larger number of chloroplasts, while the flowers are larger and more highly colored. In at least 17 species the changes are so great that the plants have apparently been transformed into distinct alpine "species." Thus *Lotus corniculatus* L. began to show decided modifications within 10 years, and finally became identical with *L. alpinus* Schleich; *Helianthemum vulgare* Gaertn. has in 30 years become *H. grandiflorum* DC.; while *Leontodon proteiformis* Vill. in 6 years is completely transformed into *L. alpinum* Vill.

For all the species able to maintain themselves with considerable altitudinal range, there seems to be an optimum altitude at which the transformations are most rapid, most complete, and where intensity of color and development of chlorenchyma reach a climax. Species of *Potentilla* may be cited as indicating individual differences of range. Thus the optimum conditions for *P. argentea* appear to be found at 1050 m., for *P. reptans* at 1500 m., and for *P. tormentilla* at about 2000 m. Cultures of alpine plants at lower altitudes showed reversed although less marked transformations. Alpine species, able to maintain themselves at various altitudes, at the lower stations gradually lost many of their typically alpine characteristics, and a list of 14 species showing such changes is given. Certain annuals taken from the

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[10] BONNIER, GASTON, Nouvelles observations sur les cultures expérimentales à diverses altitudes et cultures par semis. Rev. Gén. Bot. 32:305–326. *pls 2. figs. 4.* 1920.